

Applicants: Yoshiyuki Tanaka, et al.
Title: Method for Controlling Non-Volatile
Semiconductor Memory System
Attorney: William H. Wright Tel: (213) 337-6700
Docket No.: 81788.0265
Express Mail Label No.: EL715813209US
Sheet 1 of 45

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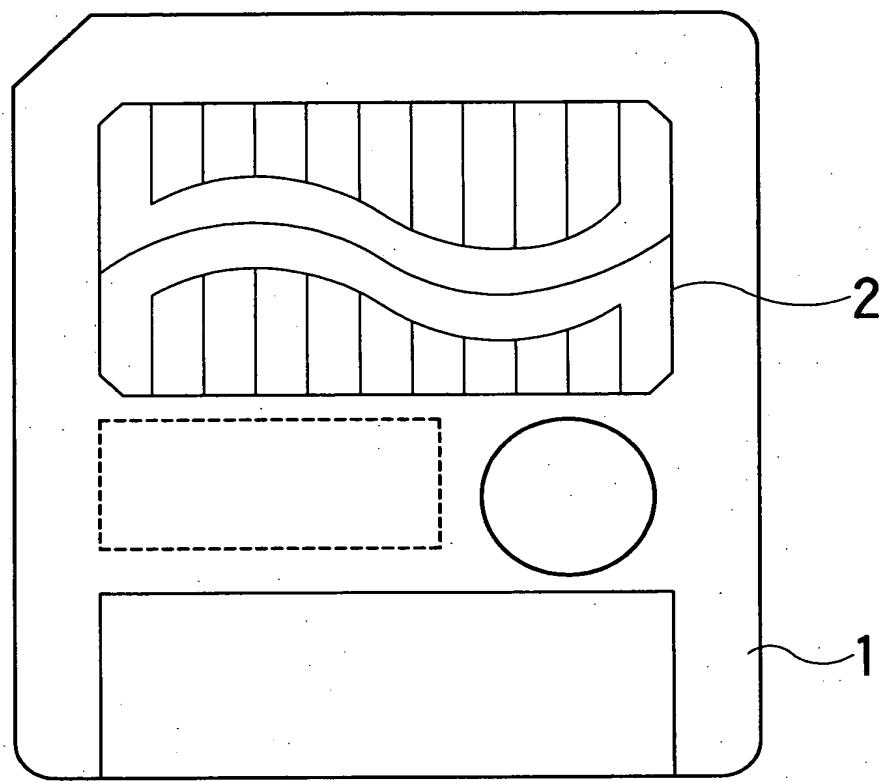


FIG. 1

PRIOR ART

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	0	255	256	263
PHYSICAL BLOCK 0	Page 0	DATA AREA (256BYTES)	REDUNDANT DIVISION (16BYTES)	
PHYSICAL BLOCK 1	Page 1			
	⋮			
PHYSICAL BLOCK 1	Page 15			
	⋮			
PHYSICAL BLOCK 511	Page 0			
PHYSICAL BLOCK 511	Page 1			
PHYSICAL BLOCK 511	⋮			
PHYSICAL BLOCK 511	Page 15			21 / 45

FIG. 2

PRIOR ART

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PHYSICAL BLOCK 0	SECTOR 0	512 BYTES
	SECTOR 1	
	⋮	
	SECTOR 7	
PHYSICAL BLOCK 1	SECTOR 8	
	SECTOR 9	
	⋮	
	SECTOR 15	
PHYSICAL BLOCK 499	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	SECTOR 3992	
	SECTOR 3993	
	⋮	
	SECTOR 3999	

FIG. 3

PRIOR ART

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DATA DIVISION

BYTE	PAGE 0(EVEN PAGE)	PAGE 1(ODD PAGE)
0~255	DATA Area-1	DATA Area-2

REDUNDANT DIVISION

BYTE	EVEN PAGE	ODD PAGE
256		
257	User Data Area	ECC Area-2
258		
259		
260	Data Status Area	Block Address Area-2
261	Block Status Area	
262	Block Address Area-1	ECC Area-1
263		

FIG. 4

PRIOR ART

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	0	511	512	527
PHYSICAL BLOCK 0	Page 0	DATA AREA	REDUNDANT DIVISION (16BYTES)	
PHYSICAL BLOCK 1	Page 0			
	Page 1			
	⋮			
	Page 15			
PHYSICAL BLOCK 1	Page 0			
	Page 1			
	⋮			
	Page 15			
	⋮	⋮	⋮	⋮
PHYSICAL BLOCK 1023	Page 0			
	Page 1			
	⋮			
	Page 15			

FIG.5

PRIOR ART

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LOGICAL BLOCK 0	SECTOR 0	512 BYTES
	SECTOR 1	
	⋮	
	SECTOR 15	
	SECTOR 16	
	SECTOR 17	
	⋮	
	SECTOR 31	
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
	⋮	⋮
LOGICAL BLOCK 1	SECTOR 15984	
	SECTOR 15985	
	⋮	
	SECTOR 15999	

FIG. 6

PRIOR ART

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DATA DIVISION

BYTE	
0~511	DATA Area

REDUNDANT DIVISION

BYTE	
512	
513	
514	User Data Area
515	
516	Data Status Area
517	Block Status Area
518	Block Address
519	Area-1
520	
521	ECC Area-2
522	
523	Block Address
524	Area-2
525	
526	ECC Area-1
527	

FIG. 7

PRIOR ART

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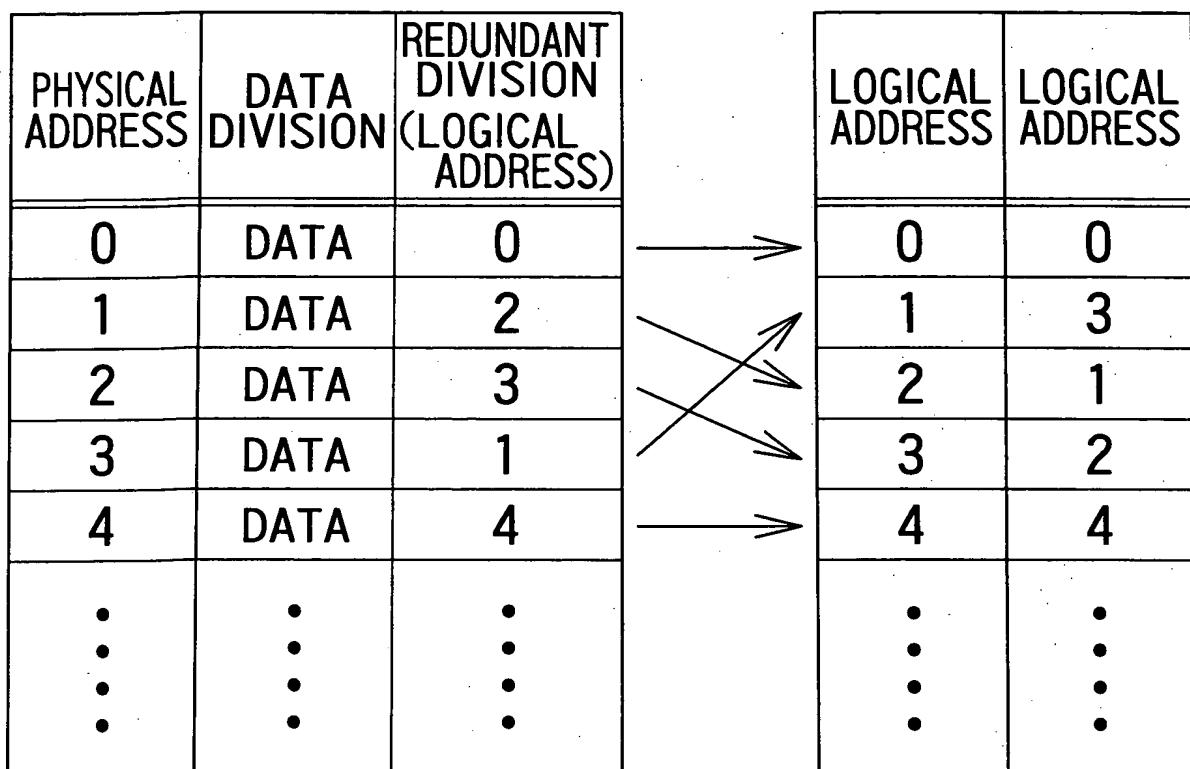


FIG. 8
PRIOR ART

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OFFSET (LOGICAL BLOCK ADDRESS)	PHYSICAL BLOCK ADDRESS	PHYSICAL BLOCK ADDRESS (BINARY DATA)			
		UPPER BYTE		LOWER BYTE	
word0(LBA=0)	0	0000	0000	0000	0000
word1(LBA=1)	500	0000	0001	1111	0100
word2(LBA=2)	327	0000	0001	0100	0111
⋮	⋮	⋮	⋮	⋮	⋮
word497(LBA=497)	244	0000	0000	1111	0100
word498(LBA=498)	249	0000	0001	1110	1111
word499(LBA=499)	128	0000	0001	1000	0000

FIG. 9
PRIOR ART

OFFSET (LOGICAL BLOCK ADDRESS)	PHYSICAL BLOCK ADDRESS	PHYSICAL BLOCK ADDRESS (BINARY DATA)			
		UPPER BYTE		LOWER BYTE	
word0(LBA=0)	0	0000	0000	0000	0000
word1(LBA=1)	1000	0000	0011	1110	1000
word2(LBA=2)	654	0000	0010	1000	1110
⋮	⋮	⋮	⋮	⋮	⋮
word997(LBA=997)	488	0000	0001	1110	1000
word998(LBA=998)	498	0000	0001	1111	0010
word999(LBA=999)	256	0000	0001	0000	0000

FIG. 10
PRIOR ART

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D7	D6	D5	D4	D3	D2	D1	D0	256 + 8 BYTE/PAGE
0	0	0	1	BA10	BA9	BA8	BA7	262 BYTE(EVEN PAGE) 259 BYTE(ODD PAGE)
BA6	BA5	BA4	BA3	BA2	BA1	BA0	P	263 BYTE(EVEN PAGE) 260 BYTE(ODD PAGE)

BA10~BA0:LOGICAL BLOCK ADDRESS
P EVEN PARITY BIT "1" FIXED VALUE

FIG. 11

PRIOR ART

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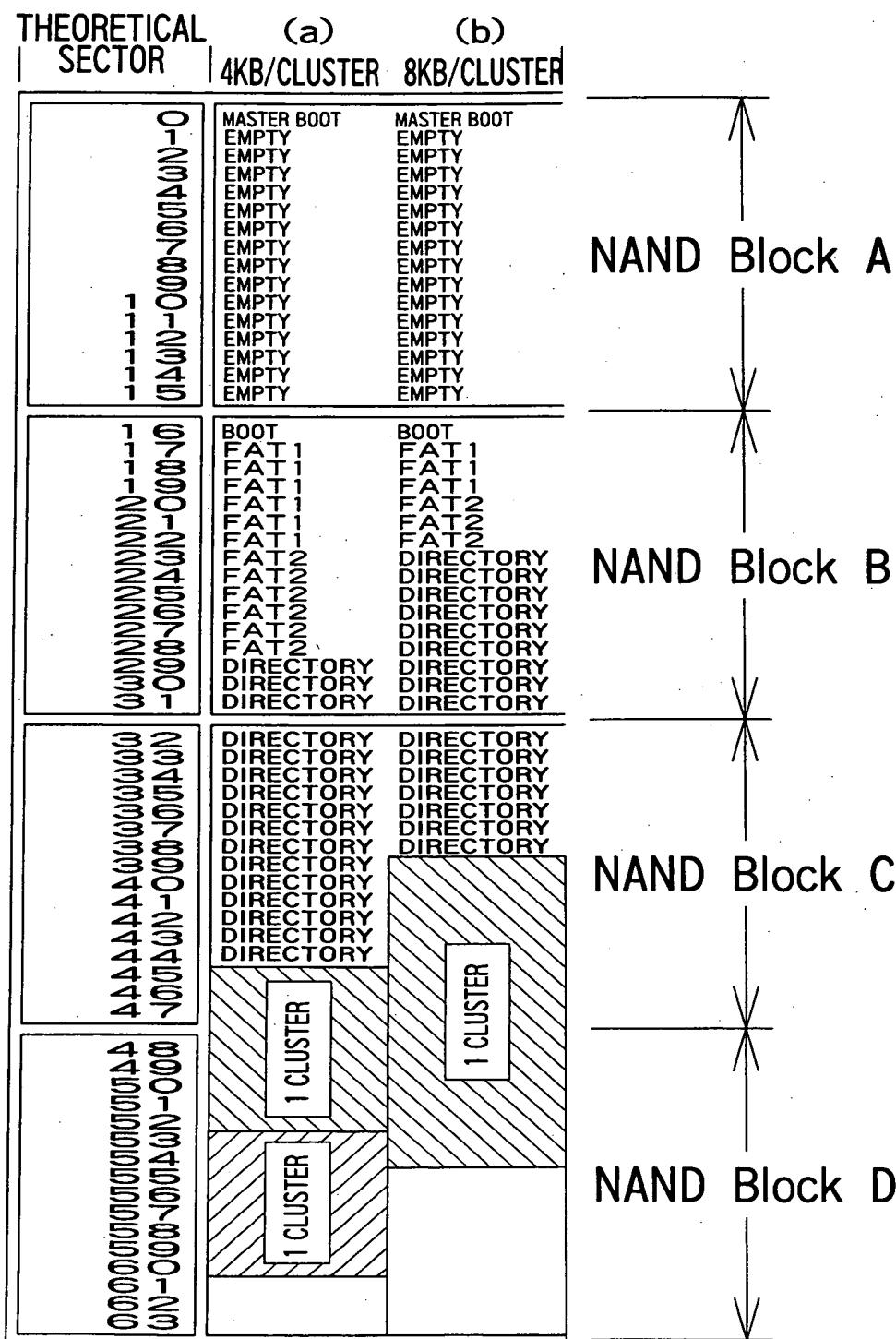


FIG. 12

PRIOR ART

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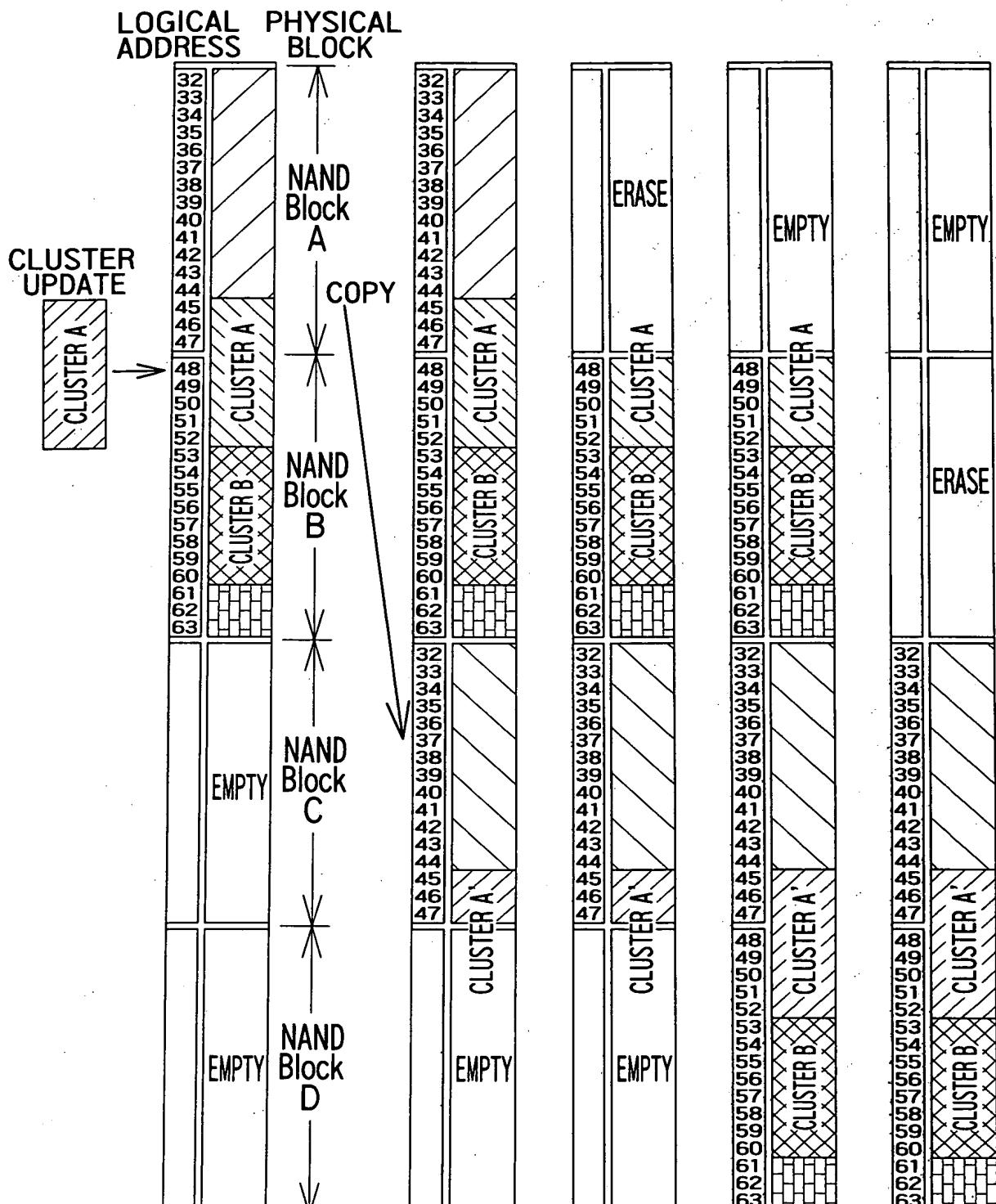


FIG. 13
PRIOR ART

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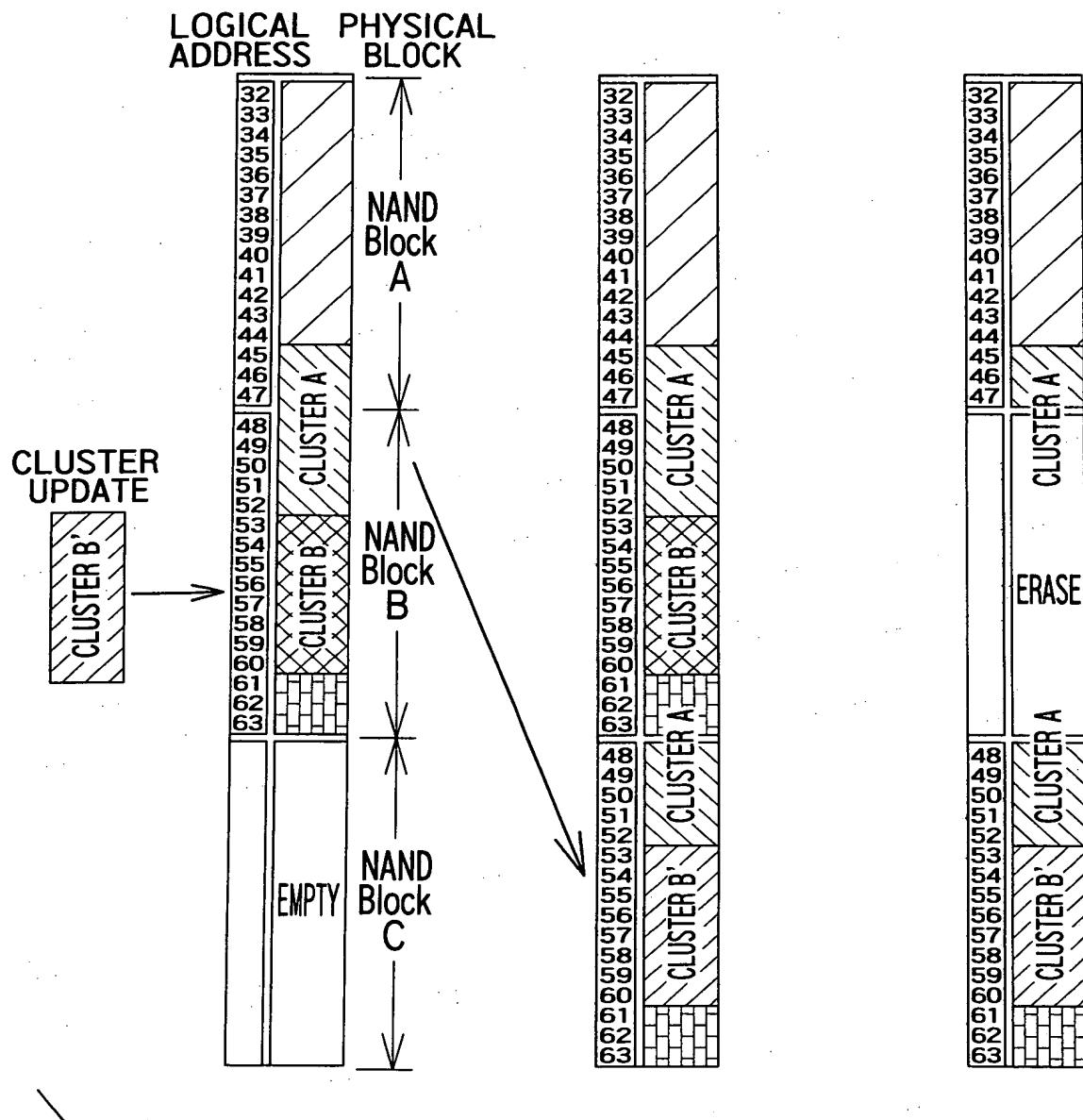


FIG. 14

PRIOR ART

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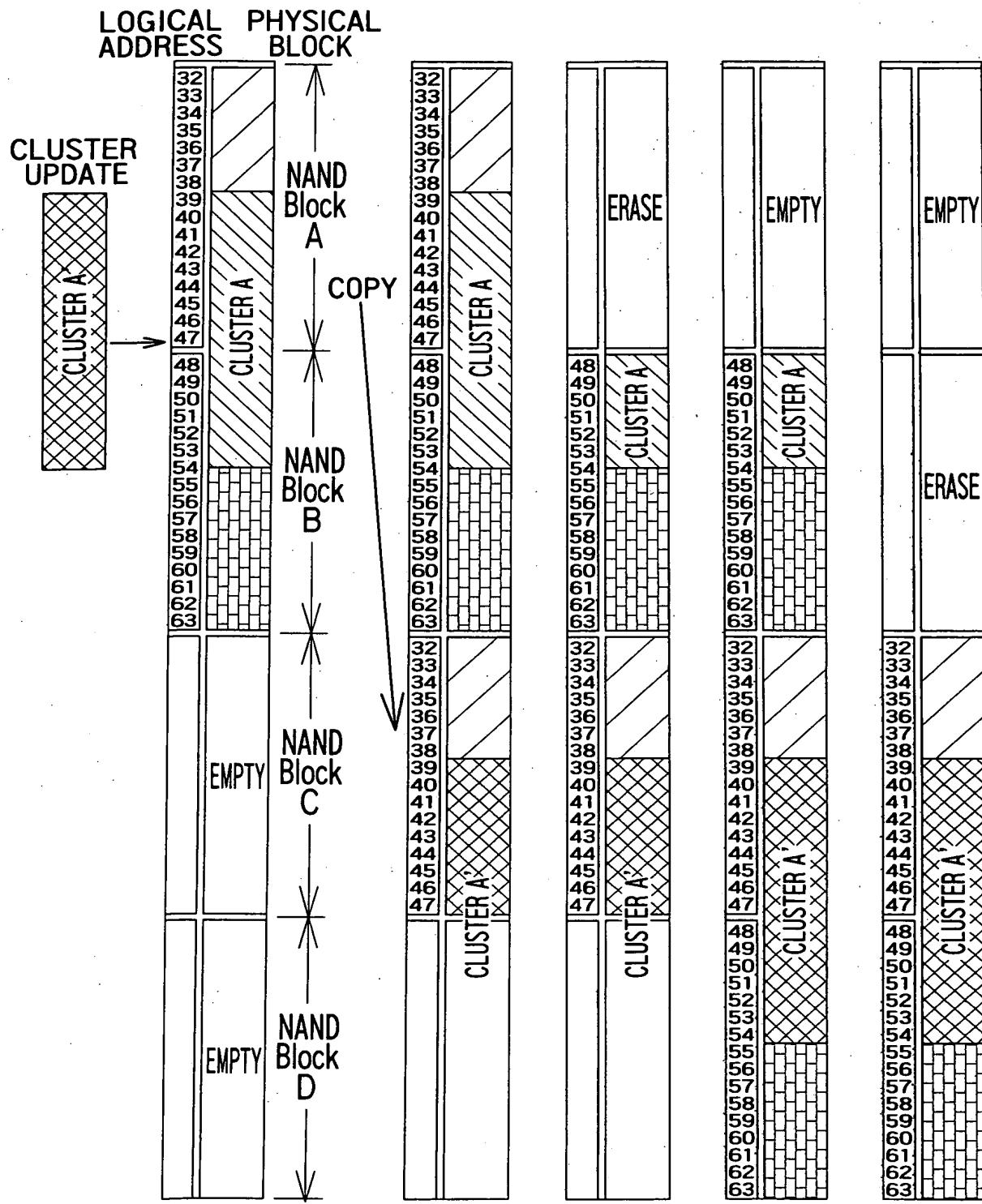


FIG. 15
PRIOR ART

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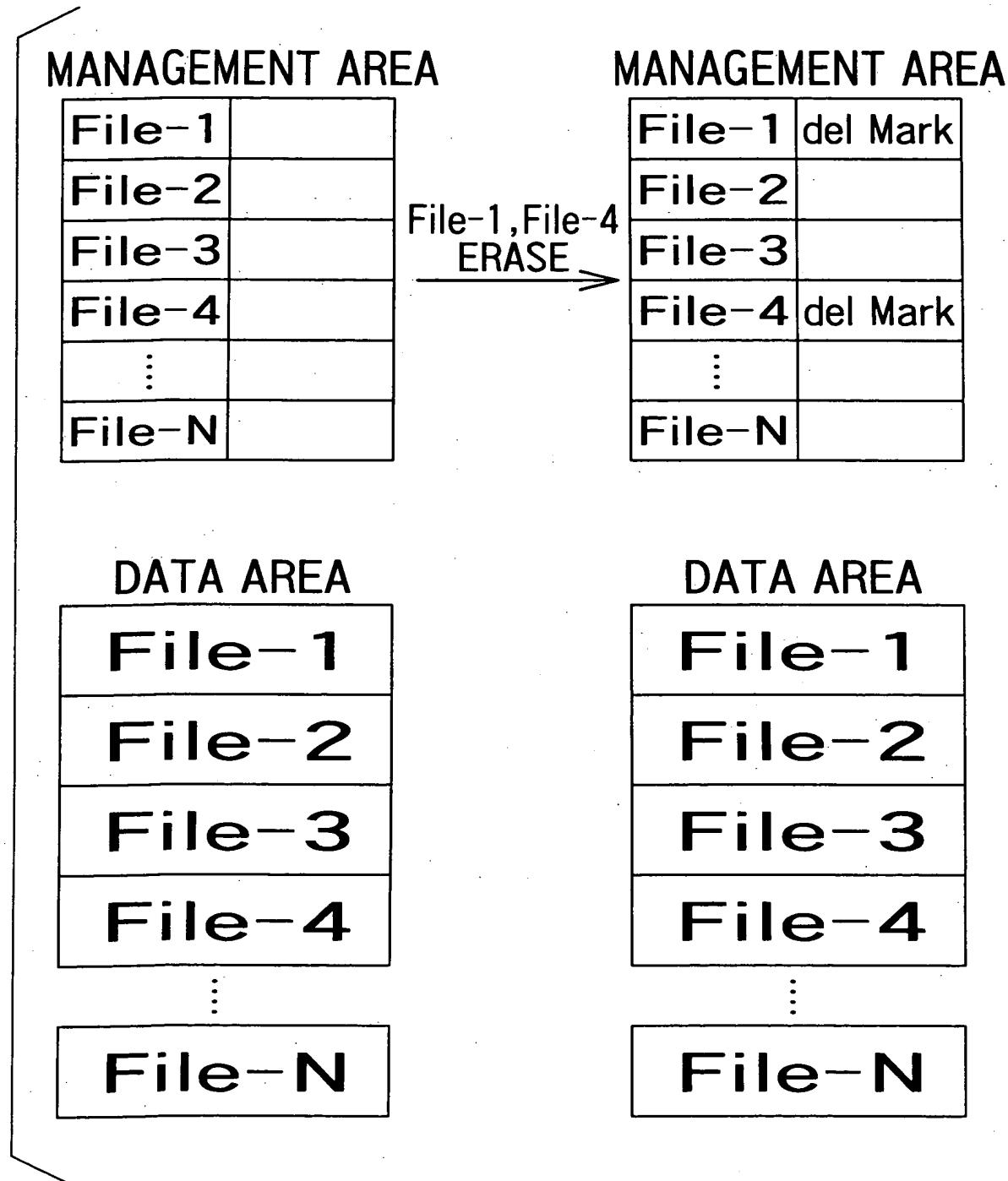


FIG. 16
PRIOR ART

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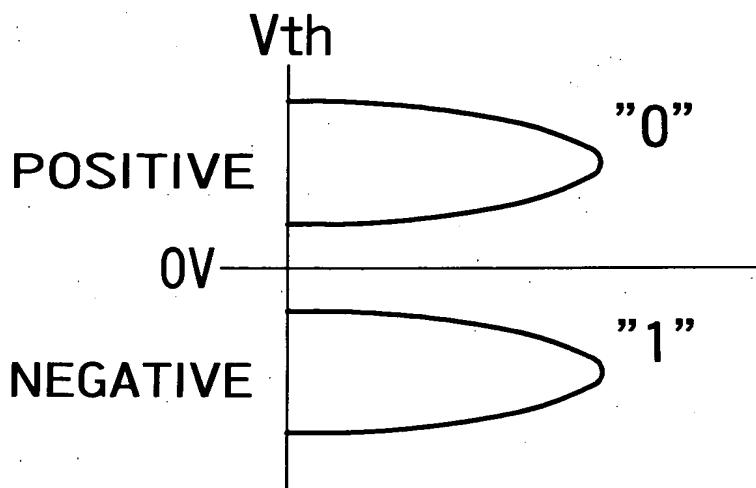


FIG. 17

PRIOR ART

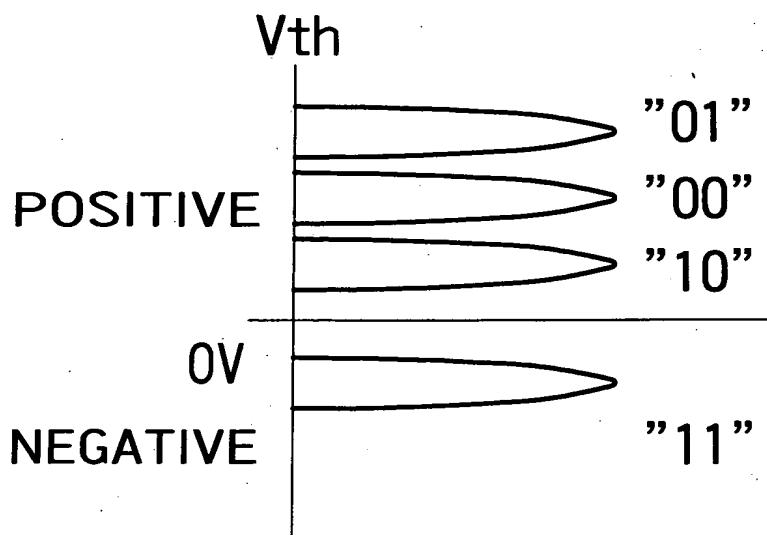


FIG. 18

PRIOR ART

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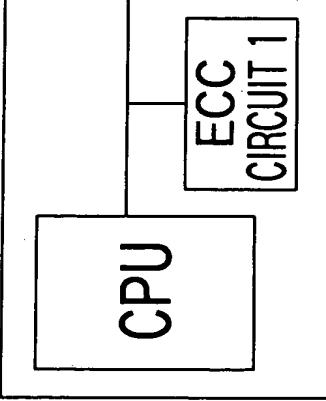
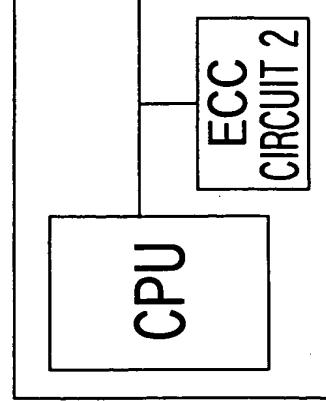
CARD IN FIG.2(a)	CARD IN FIG.2(b)		
	AVAILABLE	VUNAVAILABLE	
		AVAILABLE	VUNAVAILABLE

FIG.19
PRIOR ART

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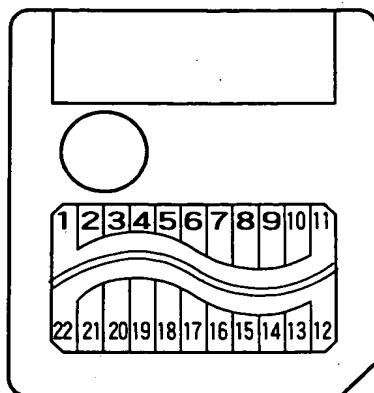


FIG. 20

1,10,11	Vss	POWER SUPPLY(GND)
2	CLE	COMMAND LATCH ENABLE
3	ALE	ADDRESS LATCH ENABLE
4	WE	WRITE ENABLE
5	WP	WRITE PROTECT
6-9	I/O1-4	ADDRESS DATA COMMAND INPUT-OUTPUT PORT
13-16	I/O5-8	ADDRESS DATA COMMAND INPUT-OUTPUT PORT
17	NC	N_C
18	GND	GND LEVEL INPUT
19	R/B	READY BUSY OUTPUT
20	RE	READ ENABLE
21	CE	CHIP ENABLE
22,23	Vcc	POWER SUPPLY

FIG. 21

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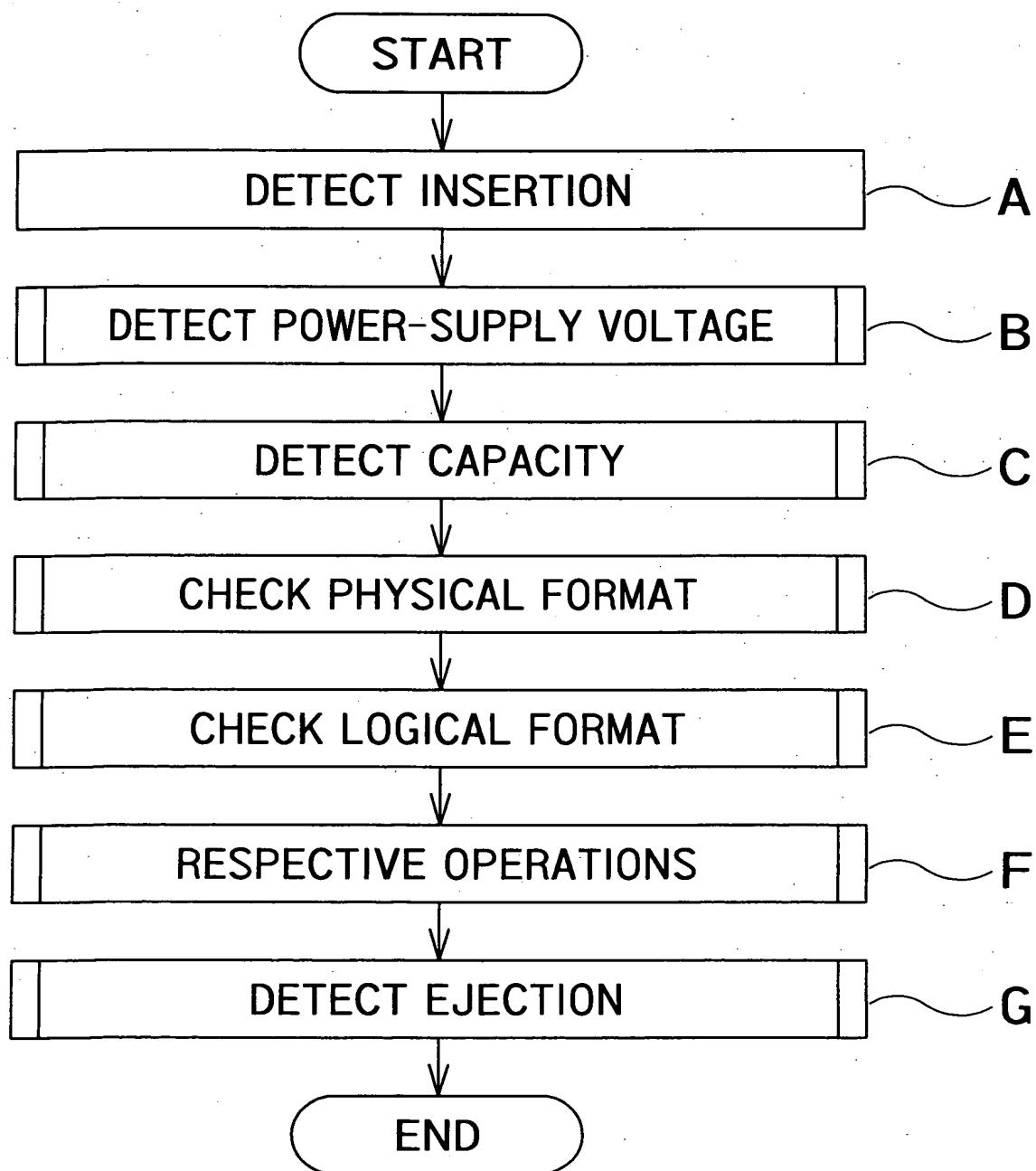
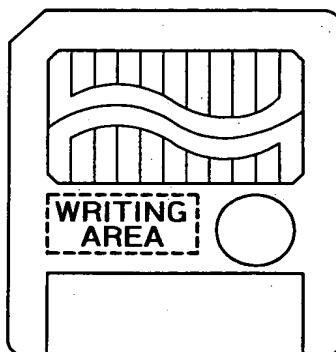


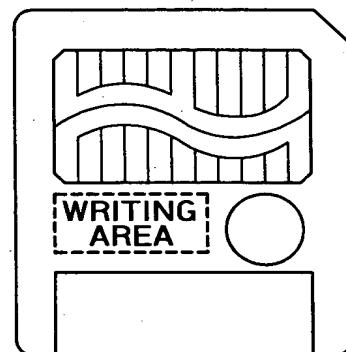
FIG. 22

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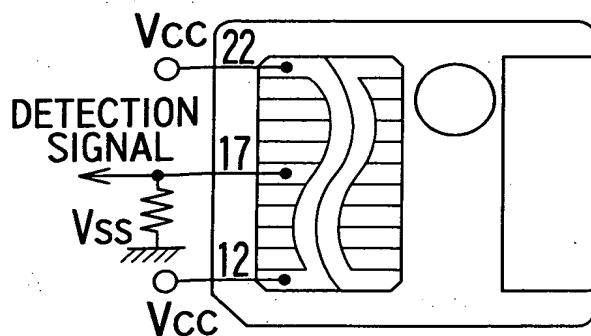
5V PRODUCT

FIG. 23(a)



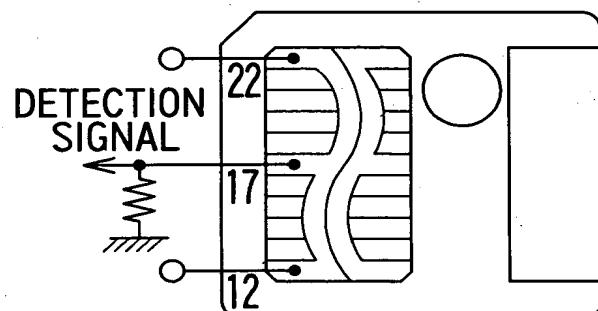
3.3V PRODUCT

FIG. 23(b)



5V PRODUCT

FIG. 24(a)



3.3V PRODUCT

FIG. 24(b)

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5V DEDICATED CONNECTOR

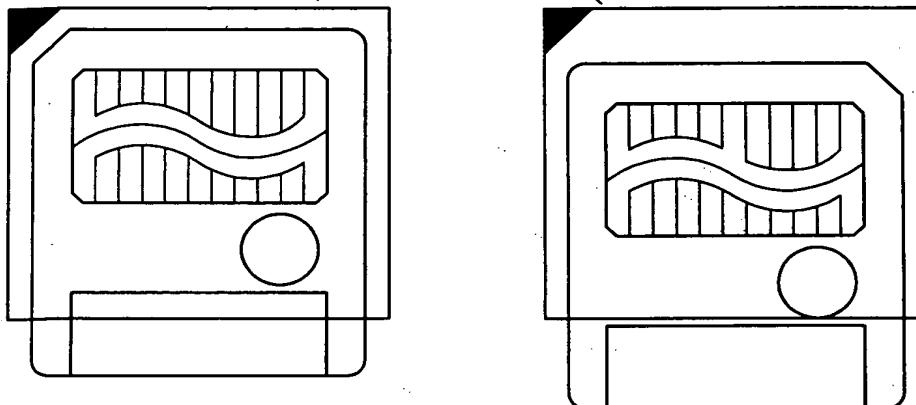


FIG. 25

3.3V DEDICATED CONNECTOR

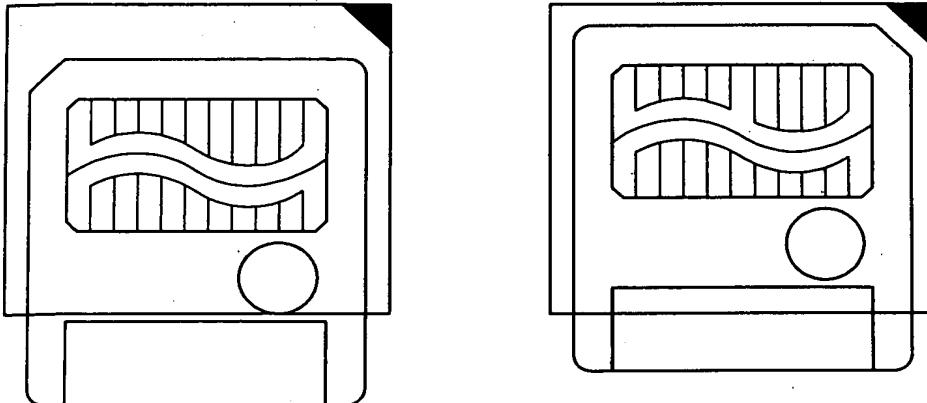


FIG. 26

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5V/3.3V DEDICATED CONNECTOR

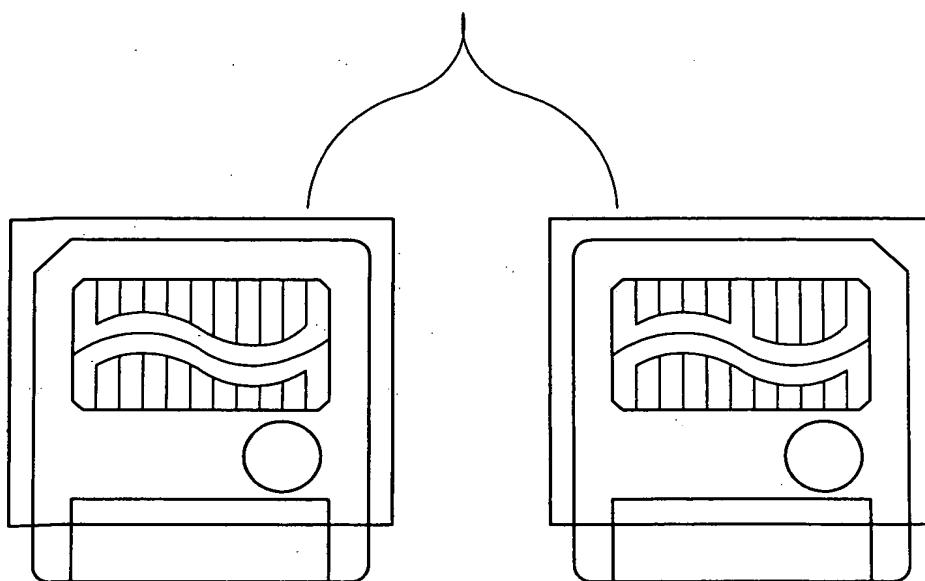


FIG. 27

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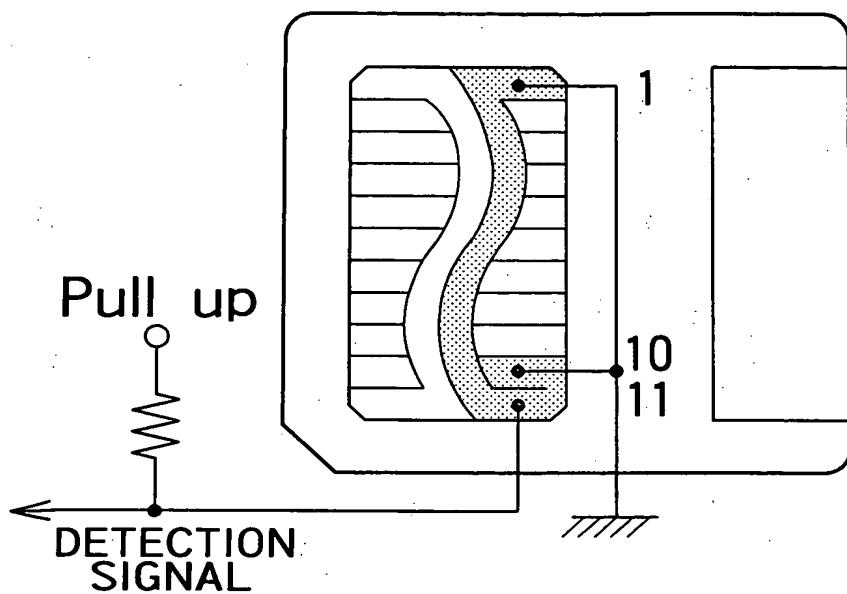


FIG. 28

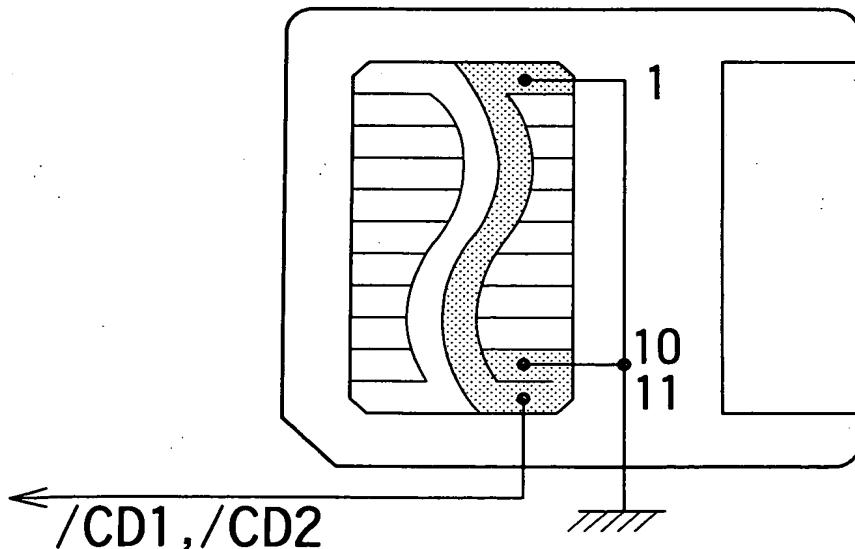


FIG. 29

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	bit7	bit6	bit1	bit0		
1stByte	00000000 111	00000000 110			00000000 001	00000000 000
2ndByte	00000000 111	00000001 110			00000001 001	00000001 000
	:	:	:	:	:	:
255thByte	11111110 111	11111110 110			11111110 001	11111110 000
266thByte	11111111 111	11111111 110			11111111 001	11111111 000

FIG. 30

LP00=D(*****0, ***) , LP01=D(*****1, ***)
 LP02=D(*****0*, ***) , LP03=D(*****1*, ***)
 LP04=D(****0**, ***) , LP05=D(****1**, ***)
 LP06=D(***0***, ***) , LP07=D(***1***, ***)
 LP08=D(**0****, ***) , LP09=D(**1****, ***)
 LP010=D(**0*****, ***) , LP011=D(**1*****, ***)
 LP012=D(*0*****, ***) , LP013=D(*1*****, ***)
 LP014=D(0******, ***) , LP015=D(1******, ***)
 LP00=D(******, **0) , LP01=D(******, **1)
 LP02=D(******, *0*) , LP03=D(******, *1*)
 LP04=D(******, 0**) , LP05=D(******, 1**)

FIG. 31

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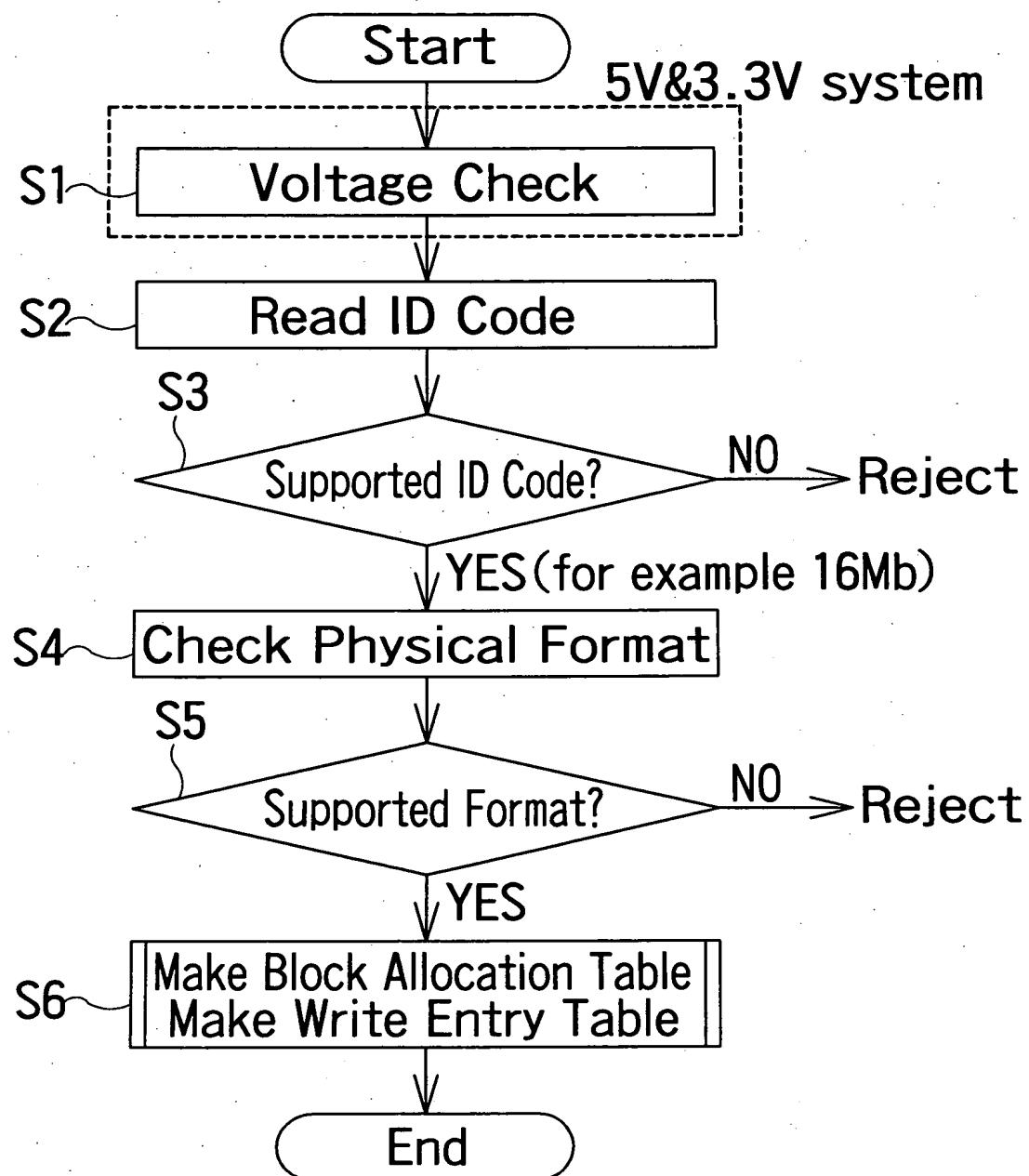


FIG. 32

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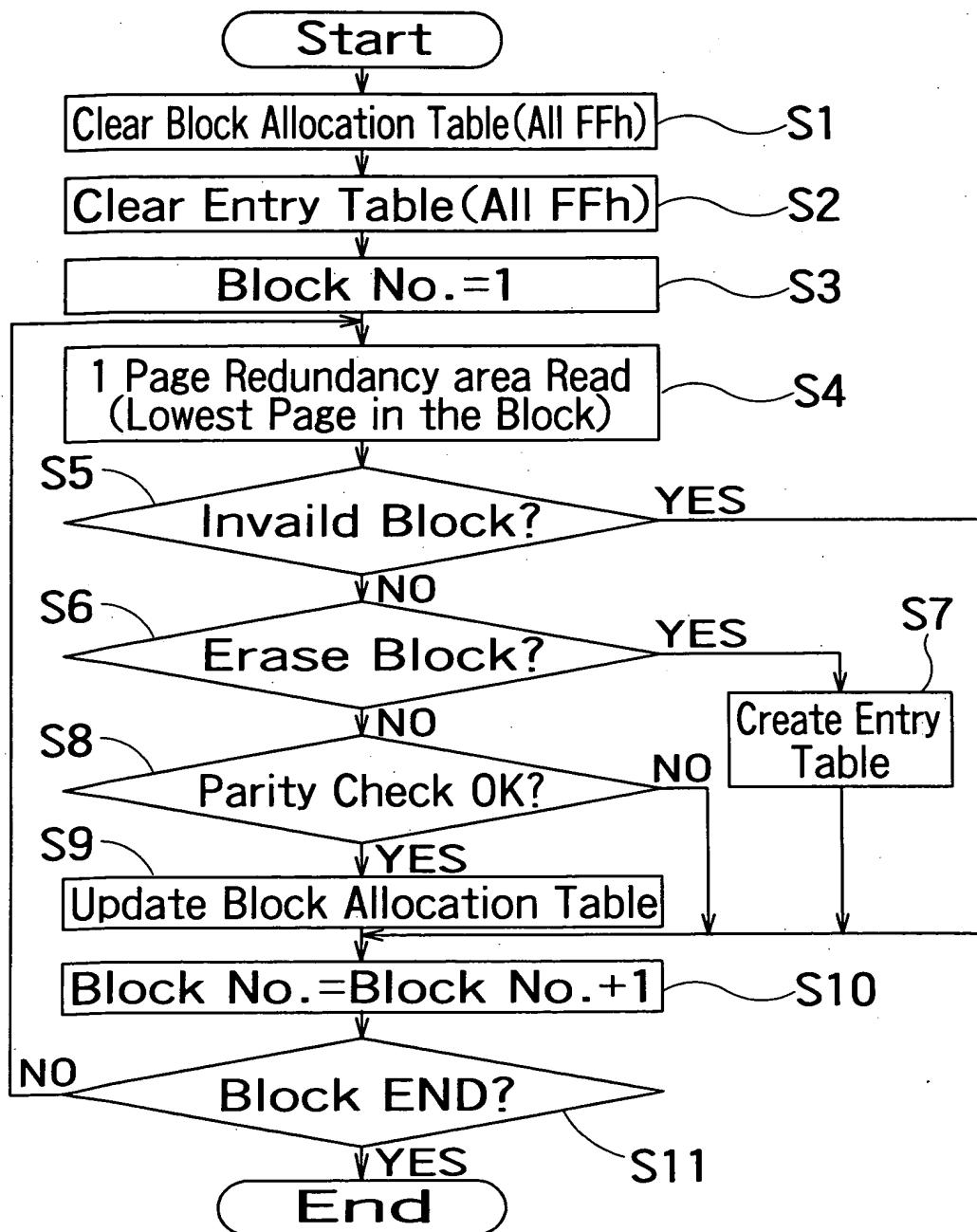


FIG. 33

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OFFSET (LOGICAL BLOCK ADDRESS)	PHYSICAL BLOCK AREA ADDRESS	PHYSICAL BLOCK AREA ADDRESS (BINARY DATA)	
Word0(LBA=0)	0	0000	0000
Word1(LBA=1)	250	1111	1010
Word2(LBA=2)	163	1010	0011
⋮	⋮	⋮	⋮
Word497(LBA=497)	122	0111	1010
Word498(LBA=498)	248	1010	1000
Word499(LBA=499)	64	0100	0000

1 PHYSICAL BLOCK AREA = 2 PHYSICAL BLOCK

FIG. 34

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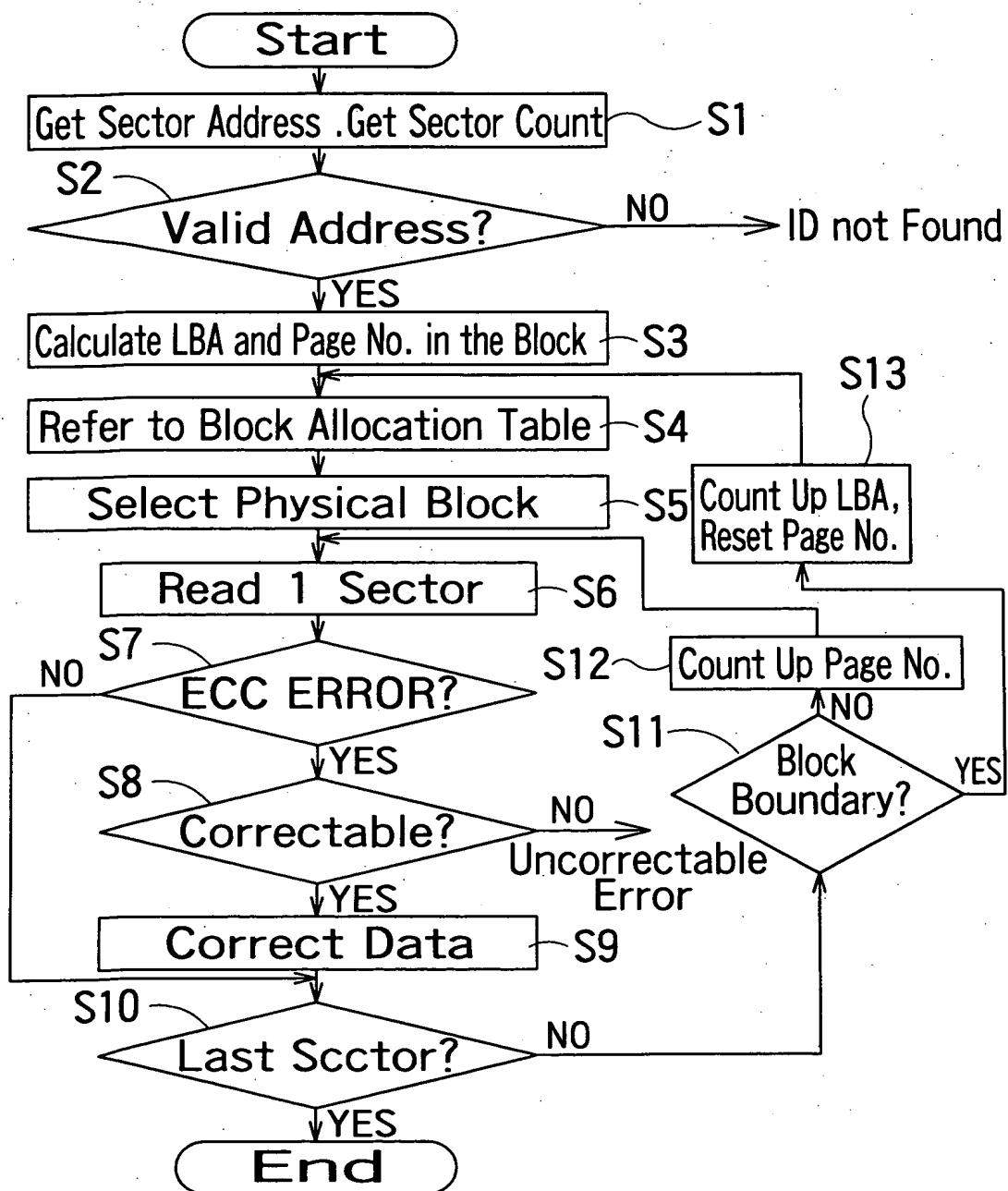


FIG. 35

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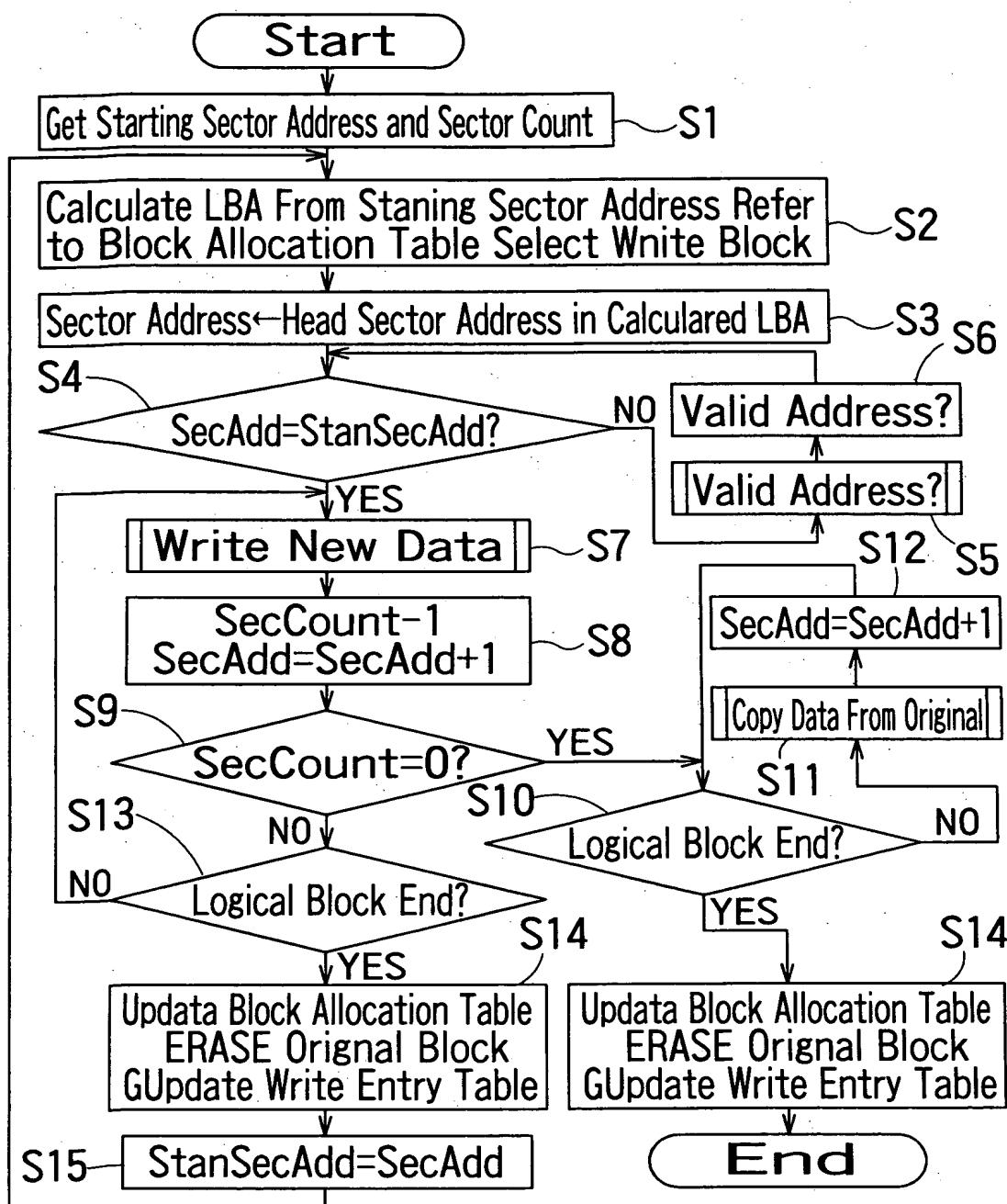


FIG. 36

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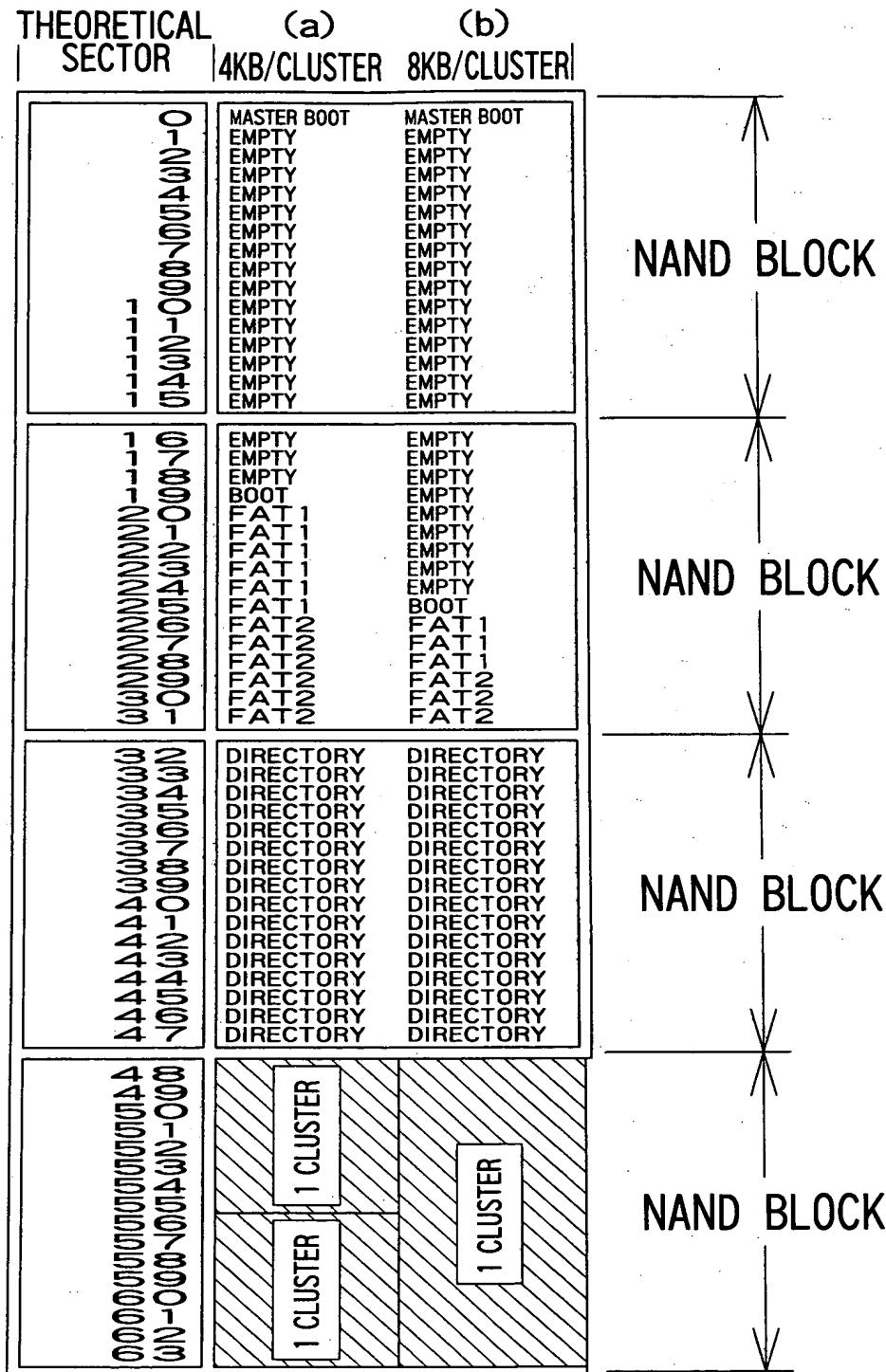


FIG. 37

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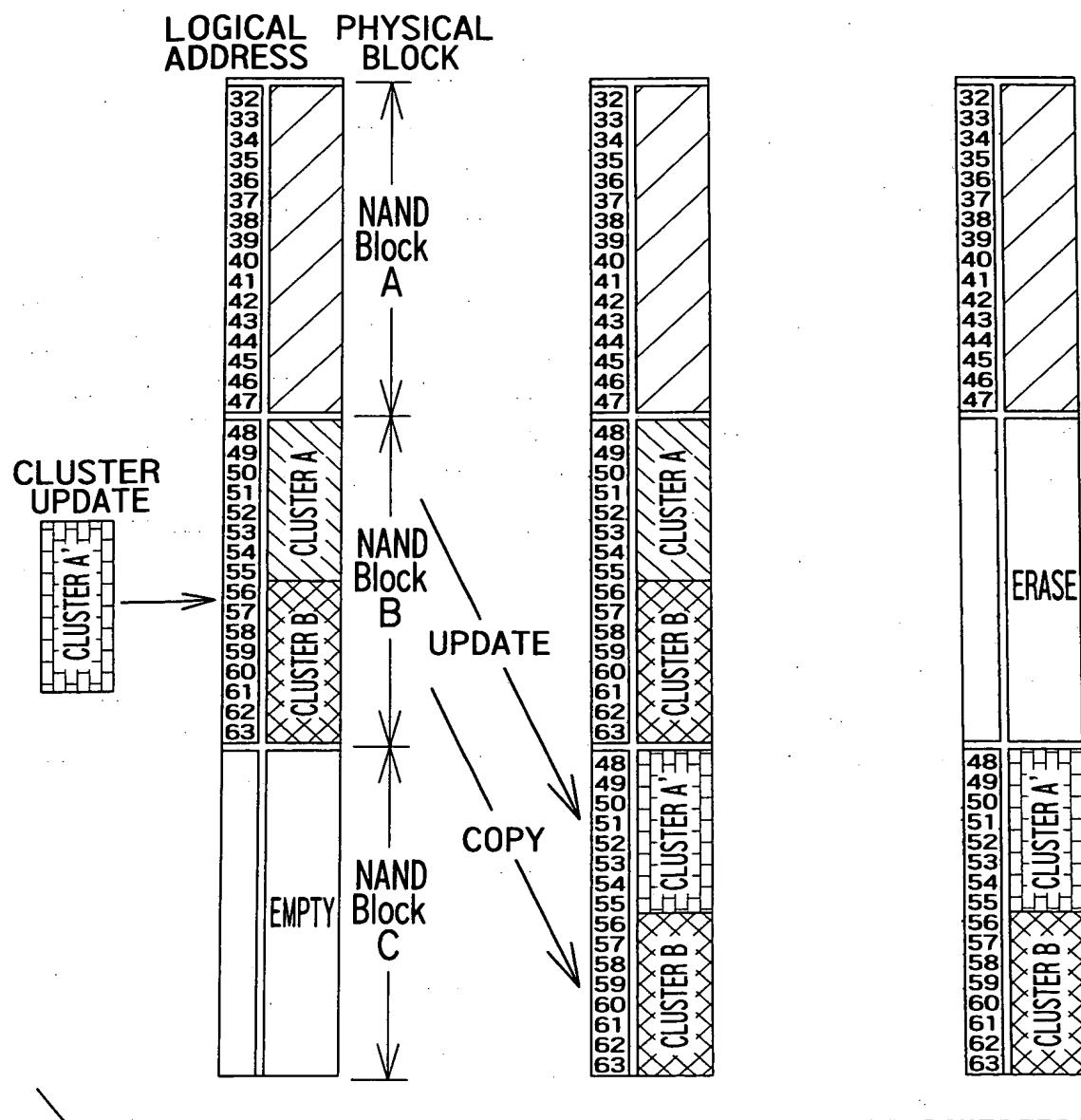


FIG. 38

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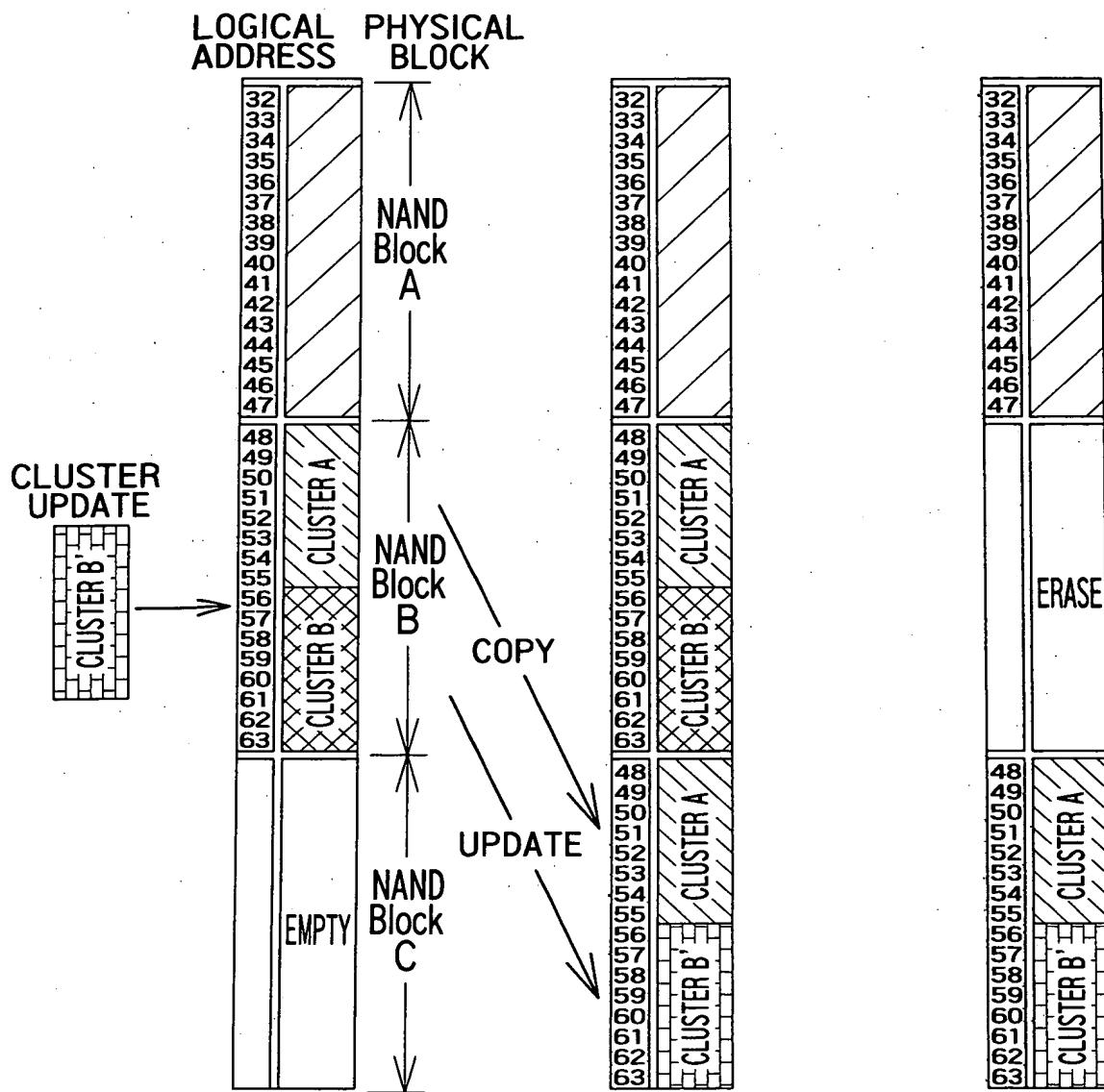


FIG. 39

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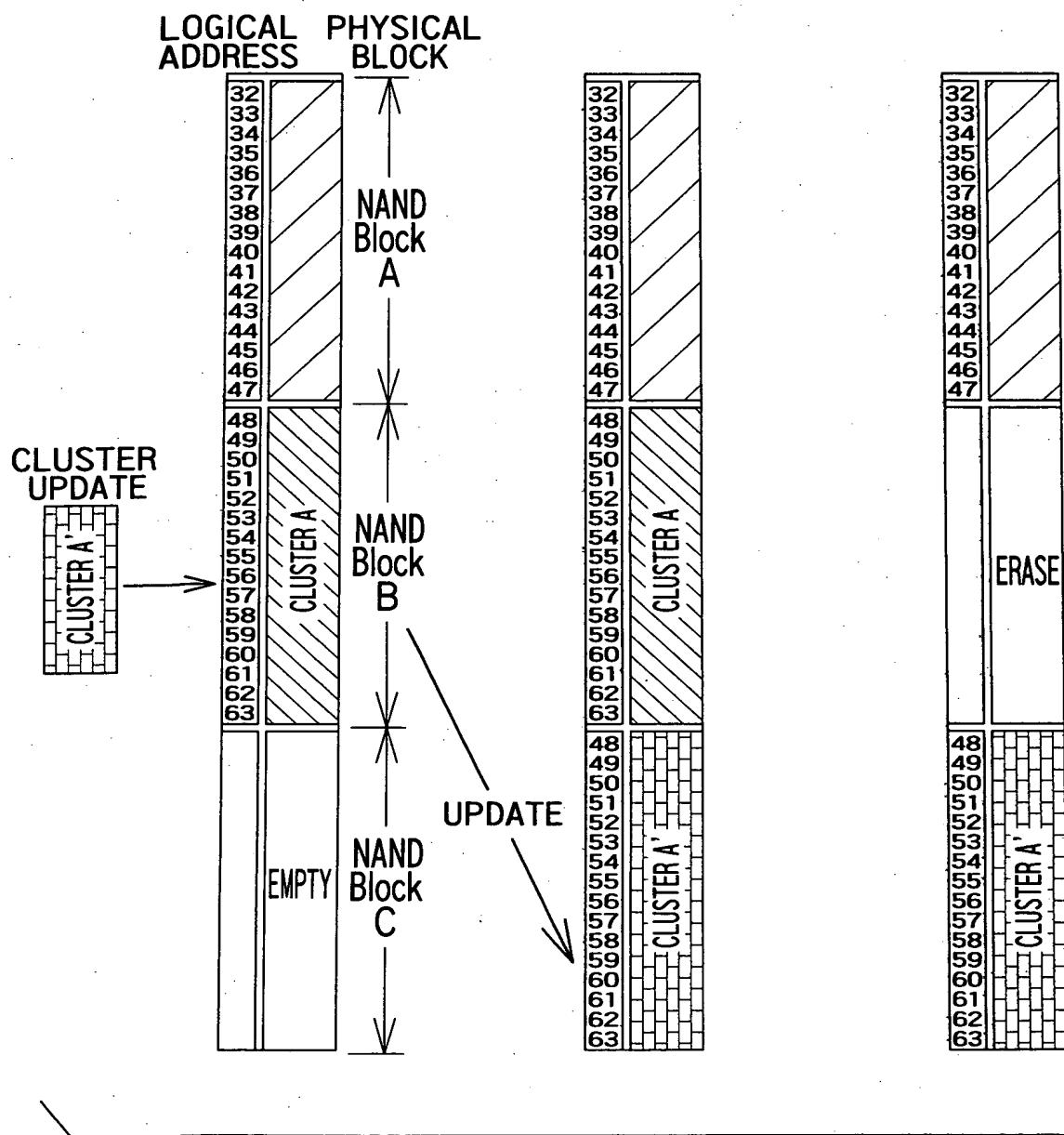


FIG. 40

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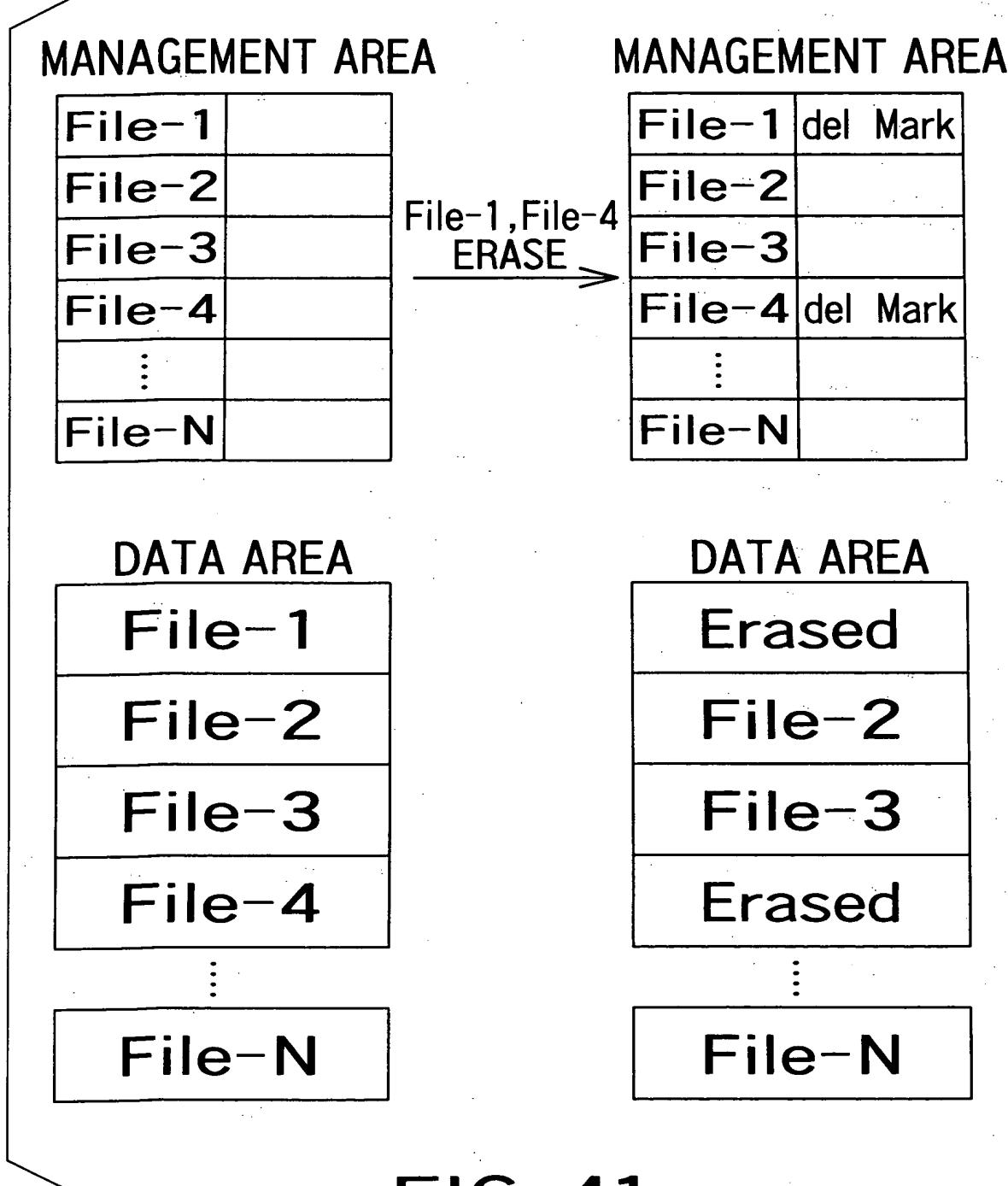


FIG. 41

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OFFSET (LOGICAL) BLOCK ADDRESS	(PHYSICAL BLOCK ADDRESS)	
	Upper Byte	Lower Byte
Word0(LBA=0)	Physical Block Upper Address	Physical Block Lower Address
Word1(LBA=1)	Physical Block Upper Address	Physical Block Lower Address
Word2(LBA=2)	Physical Block Upper Address	Physical Block Lower Address
:		
Word247(LBA=247)	Physical Block Upper Address	Physical Block Lower Address
Word248(LBA=248)	Physical Block Upper Address	Physical Block Lower Address
Word249(LBA=249)	Physical Block Upper Address	Physical Block Lower Address

FIG.42(a)

OFFSET (LOGICAL) BLOCK ADDRESS	(PHYSICAL BLOCK ADDRESS)	
	Upper Byte	Lower Byte
Word0(LBA=250)	Physical Block Upper Address	Physical Block Lower Address
Word1(LBA=251)	Physical Block Upper Address	Physical Block Lower Address
Word2(LBA=252)	Physical Block Upper Address	Physical Block Lower Address
:		
Word247(LBA=497)	Physical Block Upper Address	Physical Block Lower Address
Word248(LBA=498)	Physical Block Upper Address	Physical Block Lower Address
Word249(LBA=499)	Physical Block Upper Address	Physical Block Lower Address

FIG.42(b)

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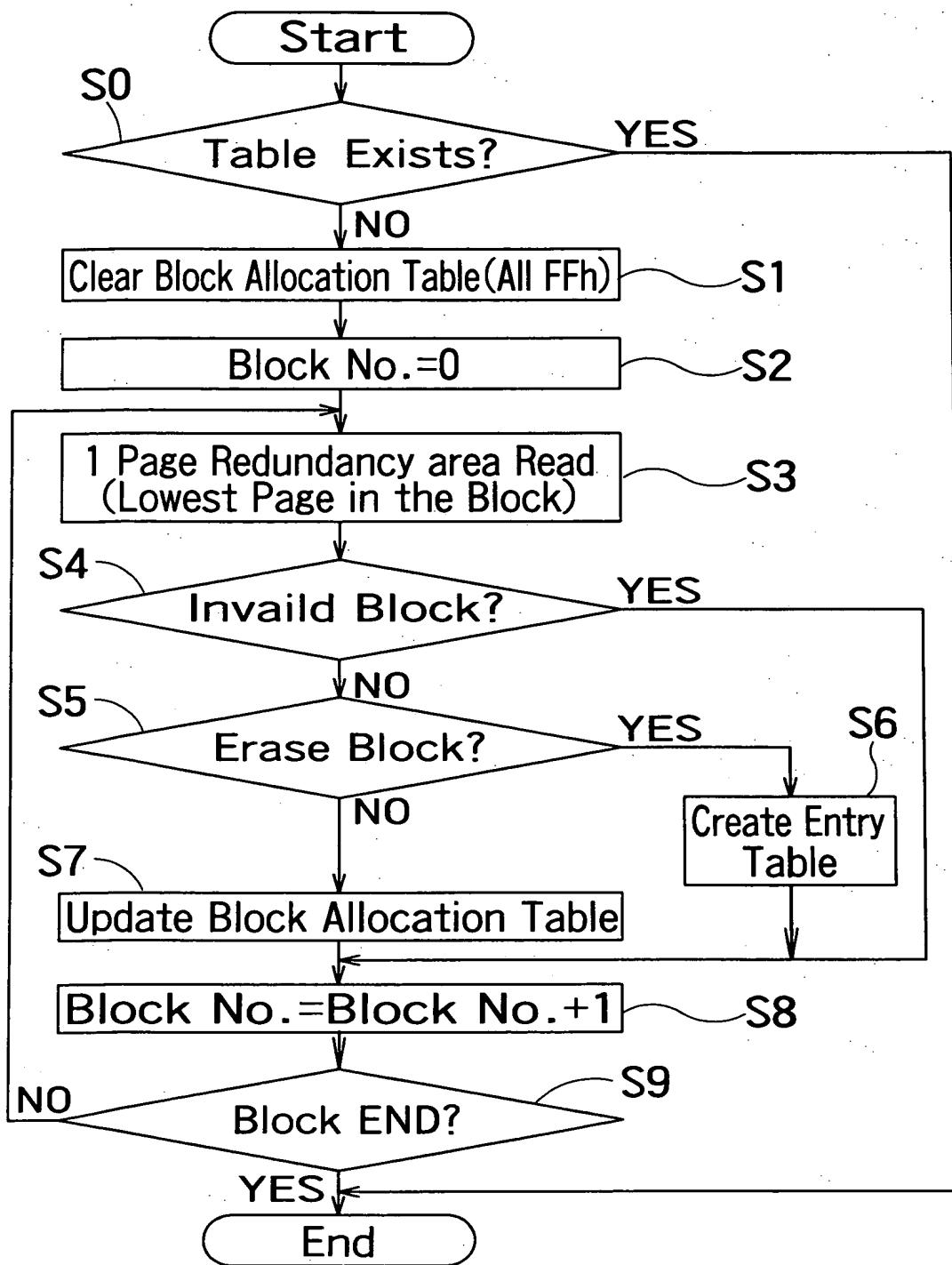


FIG. 43

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PHYSICAL BLOCK

	PHYSICAL ADDRESS	DATA DIVISION	REDUNDANT DIVISION (LOGICAL ADDRESS)
ZONE 1	0	DATA	0
	1	DATA	2
	2	DATA	3
	3	DATA	1
	4	DATA	4
	⋮	⋮	⋮
	255	DATA	249

**THEORETICAL ADDRESS/
PHYSICAL ADDRESS
CONVERTING TABLE**

LOGICAL ADDRESS	LOGICAL ADDRESS
0	0
1	3
2	1
3	2
4	4
⋮	⋮
249	255

256	DATA	0
257	DATA	3
258	DATA	4
259	DATA	1
260	DATA	2
⋮	⋮	⋮
512	DATA	249

0	256
1	259
2	260
3	257
4	258
⋮	⋮
999	512

FIG. 44

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OFFSET (LOGICAL BLOCK ADDRESS)	PHYSICAL BLOCK ADDRESS	PHYSICAL BLOCK ADDRESS (BINARY DATA)		
Word0 (LBA=0)	0	0000	0000	0000
Word2 (LBA=2)	227	0000	1110	0011
⋮	⋮	⋮	⋮	⋮
Word254 (LBA=254)	244	0000	1111	0100
Word255 (LBA=255)	128	0000	1000	0111
Word256 (LBA=256)	256(256-256=0)	0000	0000	0000
Word257 (LBA=257)	327(327-256=71)	0000	0100	0111
⋮	⋮	⋮	⋮	⋮
Word499 (LBA=499)	500(500-256=244)	0000	1110	0000
Word500 (LBA=500)	428(428-256=172)	0000	1010	1100

FIG. 45

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**BEFORE REPLACEMENT
OF BLOCK**

		PHYSICAL BLOCK ADDRESS	
		ZONE 1	ZONE 2
NG		0 Block0 data area	
NG		1 Block1 data area	
NG		2 Block2 data area	
NG		3 Block3 data area	
NG		4 Block4 data area	
NG		5 Block5 data area	
NG		6 Block6 data area	
	
NG		128 Block128 data area	
NG		129 Block129 data area	
NG		130 Block130 data area	
NG		131 Block131 data area	
NG		132 Block132 data area	
NG		133 Block133 data area	
	
NG		256 Block256 data area	
NG		257 Block257 data area	
NG		258 Block258 data area	
NG		259 Block259 data area	
NG		260 Block260 data area	
NG		261 Block261 data area	
NG		262 Block262 data area	
	
NG		384 Block384 data area	
NG		385 Block385 data area	
NG		386 Block386 data area	
NG		387 Block387 data area	
NG		388 Block388 data area	
NG		389 Block389 data area	
	

**AFTER REPLACEMENT
OF BLOCK**

		PHYSICAL BLOCK ADDRESS	
		ZONE 1	ZONE 2
NG		0 Block0 data area	
NG		1 Block1 data area	
NG		2 Block2 data area	
NG		3 Block3 data area	
NG		4 Block4 data area	
NG		5 Block5 data area	
NG		6 Block6 data area	
	
NG		128 Block128 data area	
NG		129 Block129 data area	
NG		130 Block130 data area	
NG		131 Block131 data area	
NG		132 Block132 data area	
NG		133 Block133 data area	
	
NG		256 Block256 data area	
NG		257 Block257 data area	
NG		258 Block258 data area	
NG		259 Block259 data area	
NG		260 Block260 data area	
NG		261 Block261 data area	
NG		262 Block262 data area	
	
NG		384 Block384 data area	
NG		385 Block385 data area	
NG		386 Block386 data area	
NG		387 Block387 data area	
NG		388 Block388 data area	
NG		389 Block389 data area	
	

REDUNDANT BLOCK

REDUNDANT BLOCK

2	Block2 data area
5	Block5 data area
129	Block129 data area
131	Block131 data area

FIG. 46

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**BEFORE REPLACEMENT
OF BLOCK**

**PHYSICAL BLOCK
ADDRESS**

NG	0	Block0 data area
	1	Block1 data area
NG	2	Block2 data area
	3	Block3 data area
NG	4	Block4 data area
NG	5	Block5 data area
NG	6	Block6 data area
	7	Block7 data area
NG	8	Block8 data area
NG	9	Block9 data area
	10	Block10 data area
NG	11	Block11 data area
	12	Block12 data area
	13	Block13 data area
	14	Block14 data area

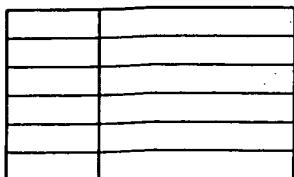
NG	256	Block256 data area
	257	Block257 data area
	258	Block258 data area
NG	259	Block259 data area
	260	Block260 data area
NG	261	Block261 data area
	262	Block262 data area
	263	Block263 data area
NG	264	Block264 data area
NG	265	Block265 data area
	266	Block266 data area
	267	Block267 data area
	268	Block268 data area
NG	269	Block269 data area

**AFTER REPLACEMENT
OF BLOCK**

**PHYSICAL BLOCK
ADDRESS**

0	Block0 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
1	Block1 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
2	Block2 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
3	Block3 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
4	Block4 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
5	Block5 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
6	Block6 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
7	Block7 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
8	Block8 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
9	Block9 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
10	Block10 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
11	Block11 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
12	Block12 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
13	Block13 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
14	Block14 data area	REDUNDANT BLOCK ∧ HARDWARE REDUNDANT
...
256	Block256 data area	...
257	Block257 data area	...
258	Block258 data area	...
259	Block259 data area	...
260	Block260 data area	...
261	Block261 data area	...
262	Block262 data area	...
263	Block263 data area	...
264	Block264 data area	...
265	Block265 data area	...
266	Block266 data area	...
267	Block267 data area	...
268	Block268 data area	...
269	Block269 data area	...
...

REDUNDANT BLOCK



REDUNDANT BLOCK

0	Block0 data area
2	Block2 data area
4	Block4 data area
5	Block5 data area
9	Block9 data area
11	Block11 data area

FIG. 47

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**BEFORE REPLACEMENT
OF BLOCK**

PHYSICAL BLOCK ADDRESS	
NG	ZONE 1
	0 Block0 data area
	1 Block1 data area
	2 Block2 data area
	3 Block3 data area
	4 Block4 data area
	5 Block5 data area
	6 Block6 data area
	⋮ ⋮
NG	
NG	
NG	
NG	
NG	ZONE 2
	128 Block128 data area
	129 Block129 data area
	130 Block130 data area
	131 Block131 data area
	132 Block132 data area
	133 Block133 data area
	⋮ ⋮
NG	ZONE 3
	256 Block256 data area
	257 Block257 data area
	258 Block258 data area
	259 Block259 data area
	260 Block260 data area
	261 Block261 data area
	262 Block262 data area
	⋮ ⋮
NG	ZONE 4
	384 Block384 data area
	385 Block385 data area
	386 Block386 data area
	387 Block387 data area
	388 Block388 data area
	389 Block389 data area
	⋮ ⋮

**AFTER REPLACEMENT
OF BLOCK**

PHYSICAL BLOCK ADDRESS	
NG	ZONE 1
	0 Block0 data area
	1 Block1 data area
	2 Block2 data area
	3 Block3 data area
	4 Block4 data area
	5 Block5 data area
	6 Block6 data area
	⋮ ⋮
NG	ZONE 2
	128 Block128 data area
	129 Block129 data area
	130 Block130 data area
	131 Block131 data area
	132 Block132 data area
	133 Block133 data area
	⋮ ⋮
NG	ZONE 3
	256 Block256 data area
	257 Block257 data area
	258 Block258 data area
	259 Block259 data area
	260 Block260 data area
	261 Block261 data area
	262 Block262 data area
	⋮ ⋮
NG	ZONE 4
	384 Block384 data area
	385 Block385 data area
	386 Block386 data area
	387 Block387 data area
	388 Block388 data area
	389 Block389 data area
	⋮ ⋮

REDUNDANT BLOCK

REDUNDANT BLOCK

129	Block129 data area
131	Block131 data area
2	Block2 data area
385	Block385 data area

FIG. 48

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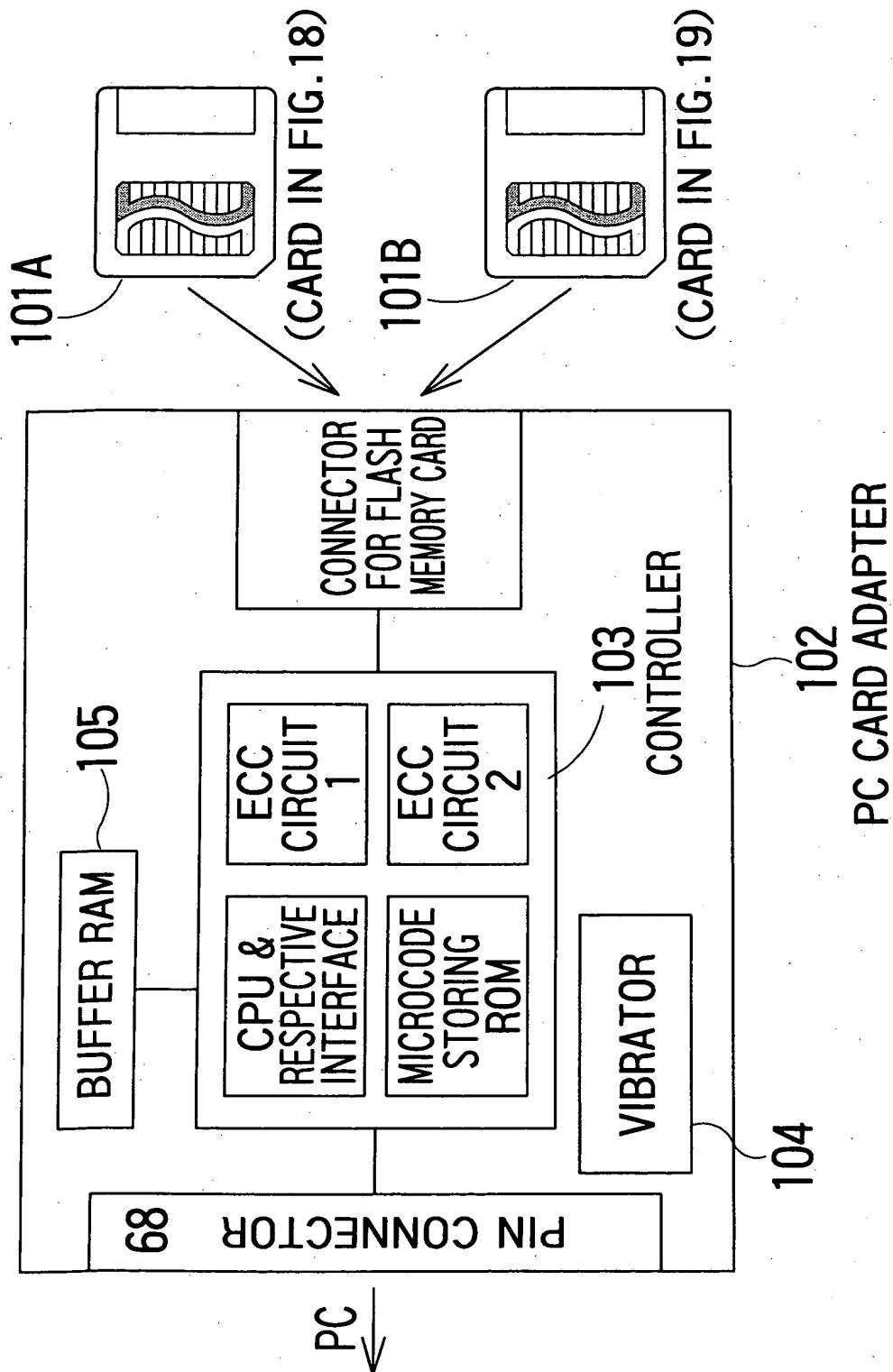


FIG. 49

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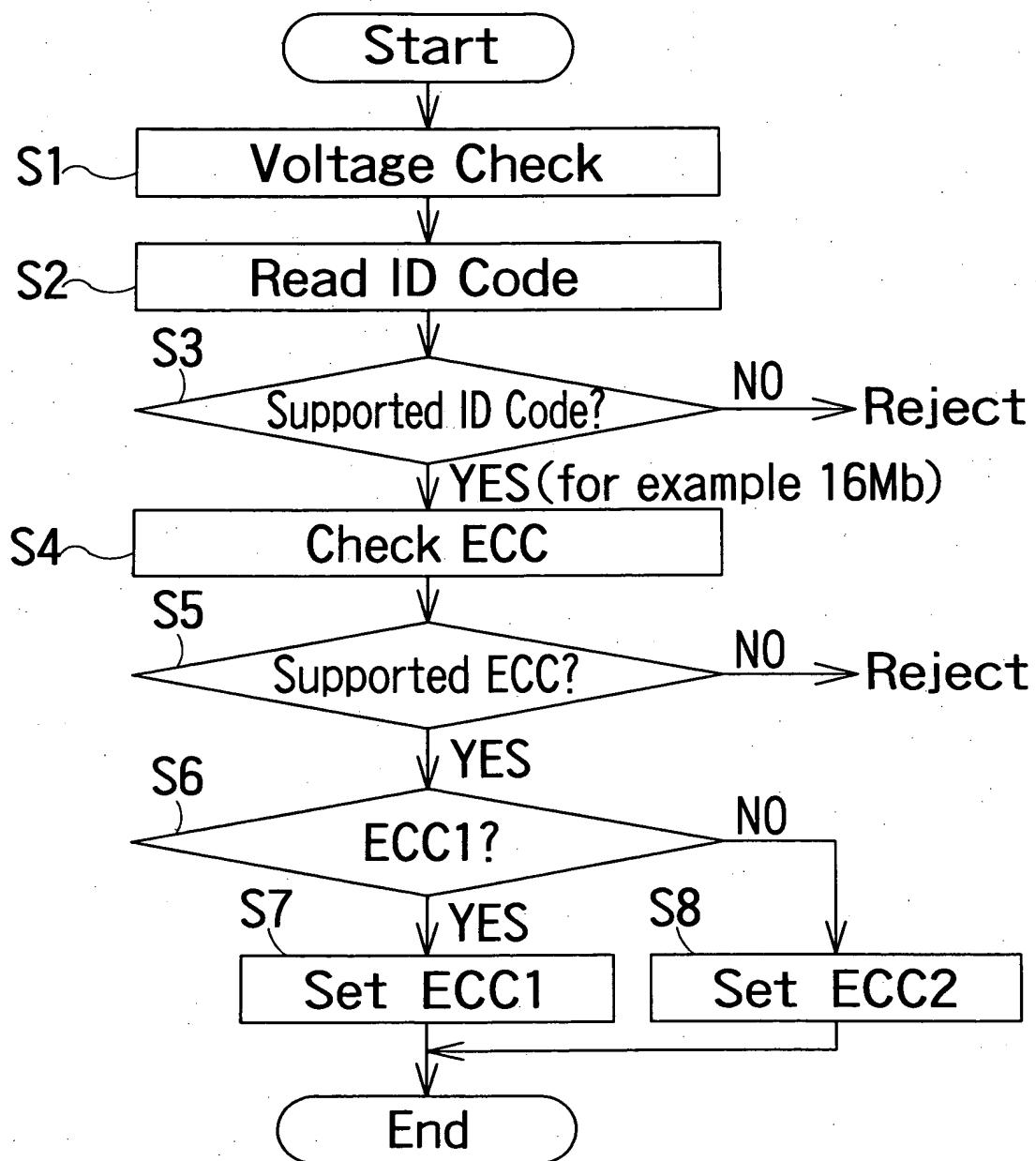


FIG.50

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DATA DIVISION

BYTE	PAGE 0(EVEN PAGE)	PAGE 1(ODD PAGE)
0~255	DATA Area-1	DATA Area-2

REDUNDANT DIVISION

BYTE	EVEN PAGE	ODD PAGE
256	ECC Flag Area	
257		ECC Area-2
258	ECC Area-3	
259		Block Address Area-2
260	Data Status Area	
261	Block Status Area	
262	Block Address Area-1	ECC Area-1
263		

FIG.51

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	ECC-AREA1	ECC-AREA2	ECC-AREA3	ECC-AREA4
ECC METHOD 1	ECC CODE FOR DATA AREA-1	ECC CODE FOR DATA AREA-2	NULL (ALL "FFh")	ECC1-FLAG
ECC METHOD 2	ECC CODE FOR DATA AREA-1,2	ECC CODE FOR DATA AREA-1,2	ECC CODE FOR DATA AREA-1,2	ECC2-FLAG

FIG. 52